

1           1. A method for the simultaneous determination of a sample thickness **L**  
2 and index of refraction **n**, the method comprising:

3           a) forming said sample with a first and a second surfaces;

4           b) forming a radiation beam and impinging said radiation beam onto said sample  
5 at a first incidence angle **A<sub>1</sub>** relative to an axis perpendicular to said first surface;

6           c) reflecting said impinged radiation beam from said first and said second  
7 surfaces of said sample forming a first and a second reflected radiation beams;

8           d) impinging said first and second reflected radiation beams on a detection  
9 device;

10          e) measuring a distance **d<sub>1</sub>** on said array between an impingement point of said  
11 first reflected beam and an impingement point of said second reflected radiation beam;

12          f) altering said first incidence angle to a second incidence angle **A<sub>2</sub>** and again  
13 measuring a distance **d<sub>2</sub>** between an impingement point of a third reflected beam and an  
14 impingement point of a fourth reflected beam on said detection device;

15          g) obtaining the sample thickness **L** and sample index of refraction **n** from the  
16 following equations:

17          
$$d_1 = [2 \cdot L/n] \cdot [\sin A_1 / (1 - (\sin^2 A_1) / n^2)^{1/2}]$$
 and

18          
$$d_2 = [2 \cdot L/n] \cdot [\sin A_2 / (1 - (\sin^2 A_2) / n^2)^{1/2}]$$

1           2. A method for the simultaneous determination of a sample thickness **L**  
2 and index of refraction **n**, the method comprising reflecting a radiation beam at a first  
3 incidence angle **A<sub>1</sub>** onto a sample having a first and a second parallel reflective surfaces  
4 and projecting a first surface reflected radiation beam and a second surface reflected

5 radiation beam onto a detection device, determining a distance  $d_1$  between said  
6 projected reflection beams onto said detection device, altering said incidence angle to a  
7 second incidence angle  $A_2$  and measuring a second distance  $d_2$  between said projected  
8 reflection beams onto said detection device, and solving the following system of  
9 equations:

10 
$$d_1 = [2 \cdot L/n] \cdot [\sin A_1 / (1 - (\sin^2 A_1) / n^2)^{1/2}] \text{ and}$$

11 
$$d_2 = [2 \cdot L/n] \cdot [\sin A_2 / (1 - (\sin^2 A_2) / n^2)^{1/2}]$$

12 to obtain values for **L** and **n**.

1       3. A method for the simultaneous determination of a sample thickness **L**  
2 and index of refraction **n**, the method comprising:

3       a) directing along an axis forming a first angle  $A_1$  with said sample a radiation  
4 beam, transmitting said radiation beam through said sample, intercepting said  
5 transmitted radiation beam by a detection device and measuring a distance  $d_1$  between a  
6 point on said detection device where said axis intercepts said detection device and a  
7 point on said detection device where said transmitted beam impinges on said detection  
8 device; and

9       b) directing said radiation beam along a second axis forming a second angle  $A_2$   
10 with said sample, again transmitting said radiation beam through said sample and  
11 measuring a second distance  $d_2$  between a point on said detection device where said  
12 second axis intercepts said detection device and a point on said detection device where  
13 said again transmitted beam impinges on said detection device; and

14       c) solving the following system of equations:

15 
$$d_1 = L [ \sin A_1 - (\sin 2A_1 \div 2(n^2 - \sin^2 A_1)^{1/2}) ] \text{ and}$$

16            $d_2 = L [ \sin A_2 - (\sin 2A_2 \div 2(n^2 - \sin^2 A_2)^{1/2}) ]$

17           to obtain values for **L** and **n**.

1           4.       The method according to any one of claims 1-3 wherein the detection  
2       device comprises a photo-detector.

1           5.       The method according to any one of claims 1-3 wherein angle  $A_1$  and  
2       angle  $A_2$  are both greater than 10 degrees.

1           6.       The method according to any one of claims 1-3 wherein the radiation  
2       beam is monochromatic.

1           7.       The method according to any one of claims 1-3 wherein the radiation  
2       beam is collimated.

1           8.       The method according to any one of claims 1-3 wherein the radiation  
2       beam is a laser beam.

1           9.       The method according to any one of claims 1-3 wherein the sample is  
2       transmits a portion of the radiation beam.

1           10.      The method according to any one of claims 1-3 wherein the sample is a  
2       liquid in a cuvette.

1           11.      The method according to any one of claims 1-3 wherein the first and the  
2       second surfaces of the sample are parallel.

1           12.      The method according to any one of claims 1-2 wherein the radiation  
2       beam is polarized and the incidence angles  $A_1$  and  $A_2$  both correspond to internal angles  
3       smaller than a total internal reflection angle at each of said surfaces.

1           13. A method for the simultaneous determination of a sample thickness  $L$   
2 and index of refraction  $n$ , the method comprising:

3           a) directing a substantially monochromatic collimated beam of radiation onto  
4 said sample along an axis forming a first angle  $A_x$  and a second angle  $A_y$  in a coordinate  
5 system having said sample in a plane defined by the x and y axis of said system,  
6 wherein said  $A_x$  is measured in a plane defined by the x and z axes and  $A_y$  in a plane  
7 defined by the y and z axes,

8           b) transmitting said beam through said sample and impinging said transmitted  
9 beam onto an array of radiation detectors arrayed in a plane parallel to said x-y plane;

10          c) measuring a first distance  $d_x$  on the x-axis between a point where said axis of  
11 monochromatic collimated beam impinges on said array of radiation detectors and a  
12 point where the monochromatic collimated beam impinges on said array of radiation  
13 detectors,

14          d) measuring a second distance  $d_y$  on the y-axis between a point where said axis  
15 of monochromatic collimated beam impinges on said array of radiation detectors and a  
16 point where the monochromatic collimated beam impinges on said array of radiation  
17 detectors; and

18          e) solving the following system of equations:

19           $d_x = L [ \sin A_x - (\sin 2A_x \div 2(n^2 - \sin^2 A_x)^{1/2}) ]$  and

20           $d_y = L [ \sin A_y - (\sin 2A_y \div 2(n^2 - \sin^2 A_y)^{1/2}) ]$

21          to obtain values for  $L$  and  $n$ .

1        14. A method for the simultaneous determination of a sample thickness **L**  
2 and index of refraction **n**, the sample having substantially parallel first and second  
3 surfaces lying in an x-y plane of a Cartesian co-ordinate system having x, y and z axes,  
4 the two surfaces separated by said distance **L** measured along the z axis, the method  
5 comprising:

6            a) directing an incident radiation beam of substantially collimated  
7 monochromatic radiation onto said sample, said radiation beam forming an angle **Ax** in  
8 the x-z plane and an angle **Ay** in the y-z plane relative to the z axis;

9            b) reflecting said incident radiation off said first and said second surfaces;

10            c) intercepting said reflected incident radiation from said first and second  
11 surfaces with an array of radiation sensors and determining a first distance **dx** and a  
12 second distance **dy** between a point of incidence on said array of radiation sensors of  
13 said radiation beam reflected from said first surface and a point of incidence of said  
14 radiation beam reflected off said second surface measured along said x axis and said y  
15 axis respectively; and

16            d) solving the following equations simultaneously for said thickness **L** and said  
17 index of refraction **n**:

18             $d_x = [2 \cdot L/n] \cdot [\sin A_x / (1 - (\sin^2 A_x) / n^2)^{1/2}]$  and

19             $d_y = [2 \cdot L/n] \cdot [\sin A_y / (1 - (\sin^2 A_y) / n^2)^{1/2}]$

1        15. The method according to claims 13 or 14 wherein said array of radiation  
2 sensors is a single two dimensional CCD sensor or an array of CCD sensors.

1        16. The method according to claims 13 or 14 wherein said array of radiation  
2 sensors is connected with a computer and said computer is programmed to measure the  
3 distances  $d_1$ ,  $d_2$ ,  $d_x$  or  $d_y$  on said array of radiation sensors.

1        17. The method according to claim 16 wherein said computer is also  
2 programmed to solve said equations for  $L$  and  $n$ .

1        18. A system for the simultaneous determination of a sample thickness  $L$  and  
2 index of refraction  $n$ , the sample having substantially parallel first and second  
3 surfaces, comprising:

4            a) a radiation beam along a path;

5            b) a holder adapted to hold said sample in said beam path at an adjustable angle  
6 relative to said sample surfaces;

7            c) a radiation detector placed to receive said radiation beam after said beam has  
8 impinged on said sample;

9            d) measuring means for measuring a distance between a reference point on said  
10 radiation detector and a point of impingement of said beam on said radiation detector

11            e) means for outputting an output indicative of said measured distance.

1        19. The system of claim 18 wherein the radiation detector comprises an  
2 array of sensors.

1        20. The system of claim 18 wherein the sample is a liquid in a cuvette.